

CLAIMS

What is claimed is:

1. A method of cleaning and drying one or more workpieces, comprising the steps of:
 - 5 immersing the workpiece in an aqueous solution in a process vessel;
providing sonic agitation into the aqueous solution;
delivering an organic vapor to a region above a surface of the aqueous solution to create a reduced surface tension at the surface of the aqueous solution;
raising the workpiece out of the aqueous solution at a controlled rate,
10 causing a liquid-vapor interface to pass across the workpiece surface; and
continuing sonic agitation while the liquid-vapor interface passes across the workpiece surface.
2. The method of claim 1 further comprising the step of irradiating the workpiece.
- 15 3. The method of claim 1 further comprising the step of delivering the organic vapor with a carrier gas.
4. The method of claim, further comprising the step of controlling the temperature of the aqueous solution.
5. The method of claim 1 wherein the workpiece are held in a vertical
20 orientation.
6. The method of claim 1 wherein the sonic agitation is provided to the workpiece through the aqueous solution from one or more sonic transducers on a surface of the process vessel.
7. The method of claim 1 wherein the controlled rate of raising is from
25 0.5mm/s to 10mm/s.
8. The method of claim 4 wherein the aqueous fluid is provided at a temperature of 15° C to 30° C.

9. The method of claim 1 wherein the aqueous solution includes at least one additive selected from the group consisting of HF, HCl, H₂O₂, NH₄OH, O₃, and H.

10. The method of claim 1 wherein the organic vapor is selected from the group consisting of isopropyl alcohol, methanol, acetone, CF₄, and CO₂.

11. The method of claim 1 further comprising the step of continuously delivering fresh aqueous solution to the process vessel to continually refresh the surface of the aqueous solution.

12. The method of claim 1 further comprising the step of supporting multiple workpieces in the process vessel.

13. A method of cleaning and drying one or more workpieces, comprising the steps of:

immersing the workpiece in an aqueous solution in a vessel;

providing sonic energy into the aqueous solution;

15 delivering an organic vapor into the vessel to create a reduced surface tension at the surface of the aqueous solution;

removing the aqueous solution from the vessel at a controlled rate with the liquid-vapor interface moving down across the workpiece surface; and

20 continuing to provide sonic energy into the aqueous solution while the liquid-vapor interface moves down across the workpiece surface.

14. The method of claim 13 wherein the workpiece remains substantially stationary during the draining step.

15. The method of claim 13 wherein the aqueous solution is removed via a drain opening in a lower region of the process vessel.

25 16. The method of claim 13 wherein the aqueous solution is removed through a porous wall in the process vessel.

17. The method of claim 16 further comprising the step of pressurizing an interior region of the vessel.

18. The method of claim 13 wherein the controlled rate of draining is from 0.5mm/s to 10mm/s.

19. The method of claim 13 further comprising the step of irradiating the workpiece.

5 20. The method of claim 13 further comprising the step of continuously delivering fresh aqueous solution to the vessel to refresh the surface of the aqueous solution.

10 21. A method of processing a workpiece, comprising the steps of:
immersing the workpiece in an aqueous solution in a process vessel;
providing sonic agitation to a surface of the workpiece;
delivering an organic vapor to a region above a surface of the aqueous
solution to create a reduced surface tension at the surface of the aqueous solution;
removing the workpiece from the aqueous solution at a controlled rate
such that a liquid-vapor interface at the surface of the aqueous solution passes
15 across the workpiece surface; and
continuing sonic agitation while the liquid-vapor interface passes
across the workpiece surface.